

WHAT IS CLAIMED IS:

1. A method for producing an electron-emitting device, comprising the steps of:

5 (A) disposing a cathode electrode on a surface of a substrate;

(B) providing an electrode opposite the cathode electrode;

10 (C) disposing plural pieces of fiber containing carbon as a main component on the cathode electrode;

and

15 (D) applying potential higher than potential applied to the cathode electrode under depressurized condition to an electrode opposite the cathode electrode.

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2. The method for producing an electron-emitting device, according to claim 1, wherein

20 said electrode opposite the cathode electrode is an anode electrode provided apart the substrate.

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3. The method for producing an electron-emitting device, according to claim 1, wherein

25 said electrode opposite the cathode electrode is a leading electrode provided apart from the cathode electrode on the surface of the substrate.

4. The method for producing an electron-emitting

device, according to claim 1, wherein

    said step of applying potential to the electrode opposite the cathode electrode is a step of increasing the number of emission sites.

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5. The method for producing an electron-emitting device, according to claim 1, wherein

    said potential applied to the electrode opposite the cathode electrode is potential at which an electron  
10     is emitted from the fiber.

6. The method for producing an electron-emitting device, according to claim 1, wherein

    said step of applying the potential to the electrode opposite the cathode electrode is performed  
15     under condition of a gas chemically or physically reactive to the fiber.

7. The method for producing an electron-emitting device, according to claim 6, wherein

    said gas chemically reactive to the fiber is one of O<sub>2</sub>, H<sub>2</sub>, CO<sub>2</sub>, and H<sub>2</sub>O.

8. The method for producing an electron-emitting device, according to claim 6, wherein

    a pressure for introducing the gas is equal to or over 1 × 10<sup>-4</sup> Pa.

9. The method for producing an electron-emitting device, according to claim 6, wherein

5           said step of applying the potential to the electrode opposite the cathode electrode is a step of applying a pulse voltage between the cathode electrode and the electrode opposite the cathode electrode.

10. The method for producing an electron-emitting device, according to claim 1, wherein

10           said fiber is formed by decomposing a hydrogen carbide gas.

11. The method for producing an electron-emitting device, according to claim 10, wherein

15           said fiber is formed by decomposing the hydrogen carbide gas using a catalyst provided on the cathode electrode in advance.

20. The method for producing an electron-emitting device, according to claim 11, wherein

20           said catalyst is one of Fe, Co, Pd, and Ni, or an alloy consisting of materials selected from among Fe, Co, Pd, and Ni.

25           13. The method for producing an electron-emitting device, according to claim 1, wherein

              said fiber is formed by graphite nanofiber, carbon

nanotube, or amorphous carbon fiber.

14. The method for producing an electron-emitting device, according to claim 1, wherein  
5 said fiber comprises a graphen.

15. The method for producing an electron-emitting device, according to claim 1, wherein  
said fiber comprises a plurality of graphens.  
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16. The method for producing an electron-emitting device, according to claim 15, wherein  
said plurality of graphens are layered in an axial direction of the fiber.  
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17. A method for producing an electron source obtained by arranging a plurality of electron-emitting devices, which are produced according to any of claims 1 to 16.  
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18. A method for producing an image-forming apparatus having an electron source and an image-forming member, wherein  
said electron source is produced in the method  
25 according to claim 17.

19. A method for producing an electron source

having a plurality of electron-emitting devices,  
comprising the steps of:

(A) providing on a substrate a plurality of  
electron-emitting devices comprising plural pieces of  
fiber each containing carbon as a main component, and  
plural pieces of wiring electrically connected to at  
least one of the plurality of electron-emitting  
devices;

(B) measuring by applying a voltage to at least a  
part of the plurality of electron-emitting devices, an  
electrical characteristic of said at least a part of  
the plurality of electron-emitting devices to which the  
voltage is applied;

(C) reducing a difference in electrical  
characteristic among the plurality of electron-emitting  
devices based on a measurement result, wherein  
said step of reducing the difference in  
characteristic among the plurality of electron-emitting  
devices comprising a step of emitting an electron from  
at least one of the plurality of electron-emitting  
devices under depressurized condition.

20. The method for producing an electron source,  
according to claim 19, wherein  
25        said plural pieces of wiring comprises plural  
pieces of row direction wiring, and plural pieces of  
column direction wiring crossing the row direction

wiring, and each of the electron-emitting devices is connected to one of the row direction wiring and one of the column direction wiring.

5           21. The method for producing an electron source, according to claim 20, wherein

              said step of reducing the difference in characteristic among the plurality of electron-emitting devices contains a step of emitting an electron from a  
10          desired electron-emitting device by repeating a step of selecting from said plural pieces of column direction wiring or said plural piece of row direction wiring, a part of the pieces of column direction wiring or row direction wiring, and emitting an electron from an  
15          electron-emitting device connected to the selected wiring.

22. The method for producing an electron source, according to claim 19, wherein

20          said step of reducing the difference in characteristic among the plurality of electron-emitting devices contains a step of emitting an electron from a desired electron-emitting device by repeating a step of selecting a part of electron-emitting devices from  
25          among the plurality of electron-emitting devices and emitting an electron from the selected electron-emitting device.

23. The method for producing an electron source,  
according to claim 19, wherein:

5        said electron-emitting device contains a cathode  
electrode to which the fiber is electrically connected,  
and a leading electrode provided apart from the cathode  
electrode; and

10      said step of emitting an electron from the  
electron-emitting device is performed by applying a  
voltage between the cathode electrode and the leading  
electrode.

24. The method for producing an electron source,  
according to claim 19, wherein

15      said step of emitting an electron from the  
electron-emitting device is performed by applying a  
voltage between the electrode provided apart from the  
substrate and the electron-emitting device.

20      25. The method for producing an electron source,  
according to claim 19, wherein:

5        said electron-emitting device contains a cathode  
electrode to which the fiber is electrically connected,  
and a leading electrode provided apart from the cathode  
electrode; and

25      said step of emitting an electron from the  
electron-emitting device is performed by applying a  
potential difference between an electrode provided

apart from the substrate and the electron-emitting device.

26. The method for producing an electron source,  
5 according to claim 19, wherein

said step of reducing the difference in characteristic among the plurality of electron-emitting devices is a step of increasing the number of emission sites of at least one electron-emitting device.

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27. The method for producing an electron source,  
according to claim 19, wherein

said step of reducing the difference in characteristic among the plurality of electron-emitting devices is performed in ambient of a gas chemically or  
15 physically reactive to the fiber.

28. The method for producing an electron source,  
according to claim 27, wherein  
20 said gas chemically reactive to the fiber contains a gas selected at least from among O<sub>2</sub>, H<sub>2</sub>, CO<sub>2</sub>, and H<sub>2</sub>O.

29. The method for producing an electron source,  
according to claim 28, wherein  
25 a pressure for introducing the gas is equal to or over 1 × 10<sup>-4</sup> Pa.

30. The method for producing an electron source,  
according to claim 27, wherein

5           said step of emitting an electron from the  
electron-emitting device is performed by applying a  
pulse voltage to the electron-emitting device.

31. The method for producing an electron source,  
according to claim 19, wherein

10          said fiber is formed by decomposing a hydrogen  
carbide gas.

32. The method for producing an electron-emitting  
device, according to claim 31, wherein

15          said fiber is formed by decomposing the hydrogen  
carbide gas using a catalyst provided on the cathode  
electrode in advance.

33. The method for producing an electron-emitting  
device, according to claim 32, wherein

20          said catalyst is one of Fe, Co, Pd, and Ni, or an  
alloy consisting of materials selected from among Fe,  
Co, Pd, and Ni.

25          34. The method for producing an electron-emitting  
device, according to claim 19, wherein

              said fiber is formed by graphite nanofiber, carbon  
nanotube, or amorphous carbon fiber.

35. The method for producing an electron-emitting device, according to claim 19, wherein  
said fiber comprises a graphen.

5       36. The method for producing an electron-emitting device, according to claim 19, wherein  
said fiber comprises a plurality of graphens.

10      37. An electron-emitting device according to  
claim 36, wherein  
said plurality of graphens are layered in an axial direction of the fiber containing carbon as a main component.

15      38. A method for producing an image-forming apparatus having an electron source and an electron-emitting member, wherein  
said electron source is produced in the method according to any of claims 19 to 37.

20      39. The method for producing an image-forming apparatus, according to claim 38, wherein  
said image-forming apparatus is obtained by seal bonding a first substrate provided with the image-forming member with a second substrate provided with the electron source; and an electrical characteristic of the electron-emitting device is measured before the

first and second substrates are seal bonded with each other.

40. The method for producing an image-forming  
5 apparatus, according to claim 38, wherein  
said image-forming apparatus is obtained by seal  
bonding a first substrate provided with the image-  
forming member with a second substrate provided with  
the electron source; and said step of reducing the  
10 difference in electrical characteristic among the  
plurality of electron-emitting devices is performed  
before the first and second substrates are seal bonded  
with each other.